Data plane Enhancement Taxonomy

draft-ietf-detnet-dataplane-taxonomy-03

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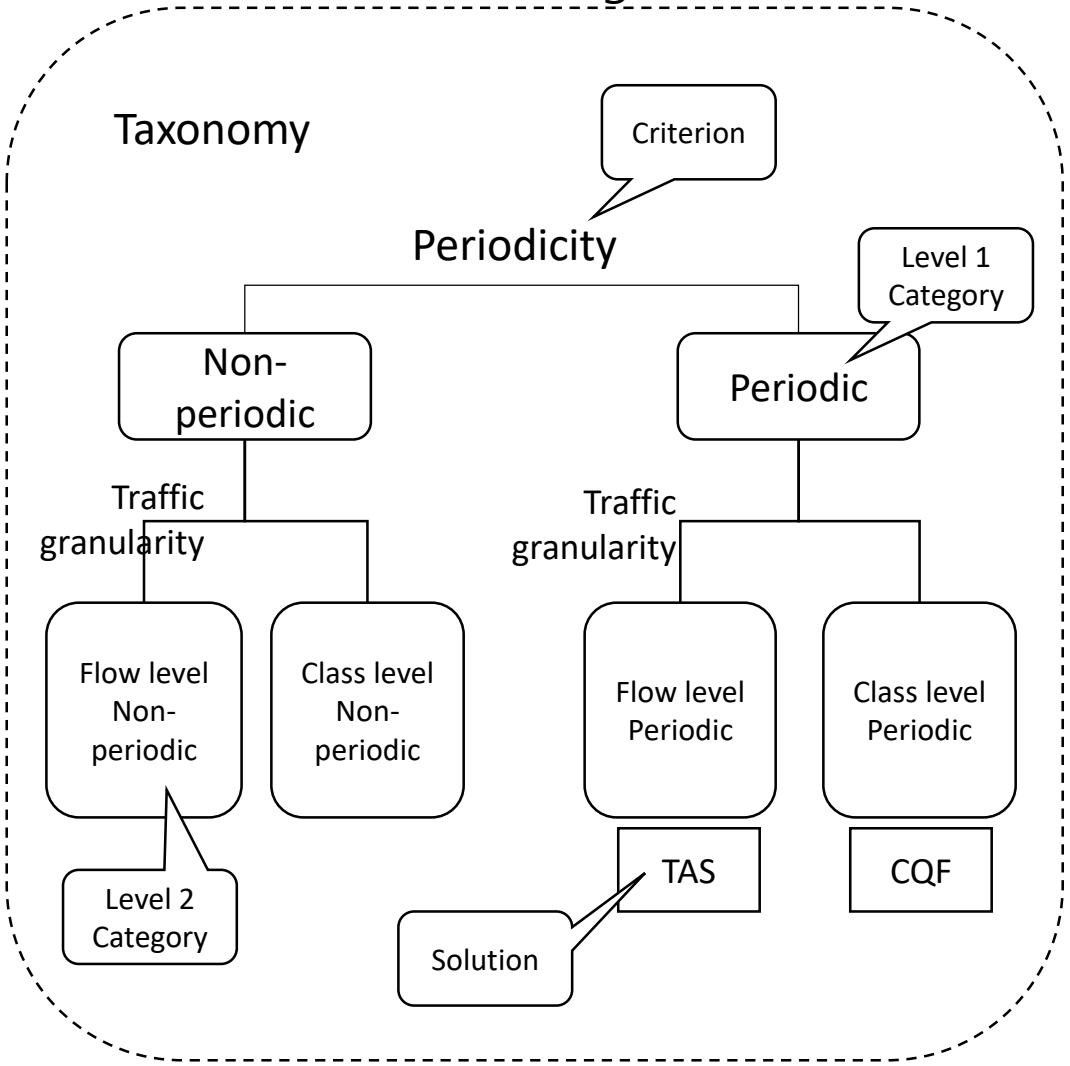
Resolution on IETF 121 meeting

- Resolution:
  - At most one solution per a category will be selected and progressed as a WG document.
  - Come up with only a few categories, within which solutions can be suitable to DetNet.
- Considerations:
  - The taxonomy draft was suggesting six functional criteria.
  - If two categories are distinguished by a single criterion, then there can be at most 2^6 = 64 families, which is too many.
  - We need exclusion and merging of criteria/categories, based on their interdependencies and properties.

Definitions of terminologies

- solution
  - A set of data plane functional entities, such as queue, scheduler, and regulator; which can guarantee a certain level of latency and jitter performance to a flow
- taxonomy
  - A systematic method by which a solution is put into a category
- category
  - A set of solutions that is put together by one or more criteria
- criterion
  - A principle or standard by which a solution can be judged or decided to be put into a certain category
- level of category
  - The number of criteria that are used to determine a category
- suitable category
  - A category within which solutions can be suitable for deterministic networking

Illustration for terminologies



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Revised. There are now only four functional criteria.

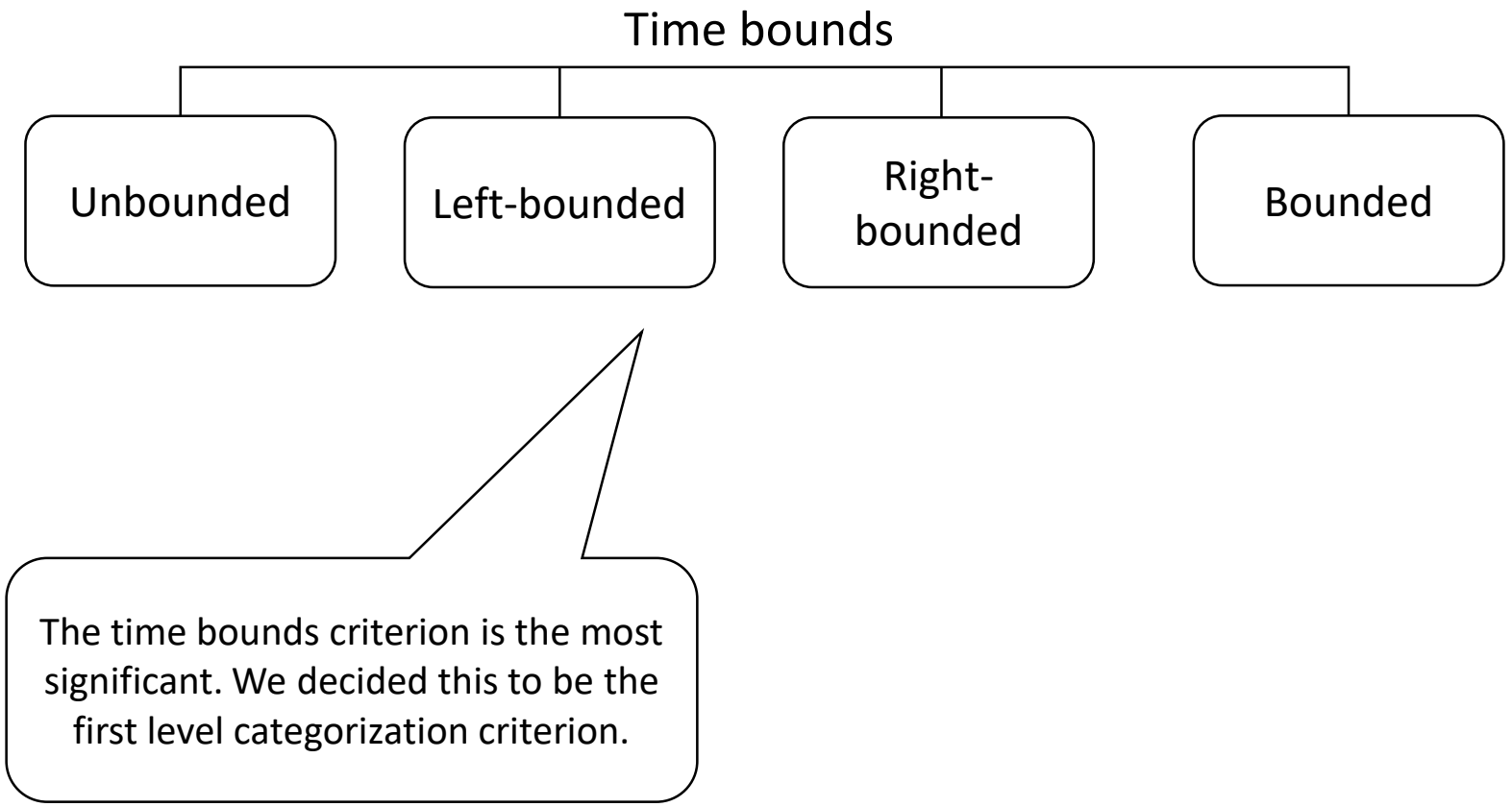
Seven suitable categories are specified.

The approach we took to come up with only a few suitable categories

- Binding of criteria:
  - Performance related criterion (*Per-hop dominant factor for latency bound*) is not used.
  - Related criteria were merged into one, considering their interdependencies. Now there are four functional criteria instead of six.
- Prioritize the criteria:
  - List the criteria in the order of their significance.
- Exclusion of categories:
  - Categories that are unsuitable for DetNet are excluded.

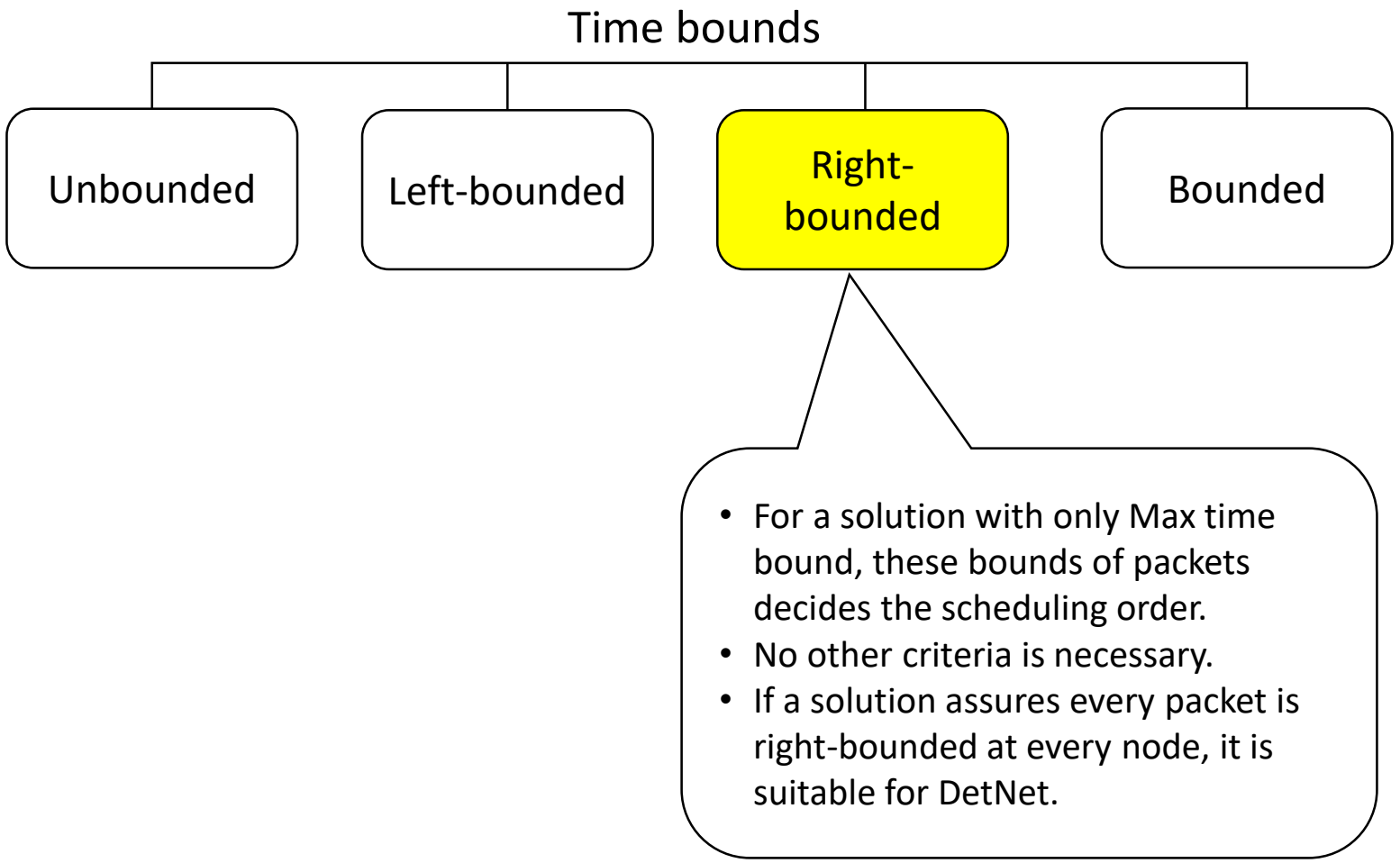
Category selection process (1/5)

- The *Time bounds* criterion, which is considered the most significantly define a solution's characteristics, is made by merging *Work conserving* and *Target transmission time*.
- By this criterion, the following four categories are distinguished.
  - Unbounded: A solution without minimum time bound nor maximum time bound
  - Left-bounded: with minimum time bound but without maximum time bound
  - Right-bounded: without minimum time bound but with maximum time bound
  - Bounded: with both minimum time bound and maximum time bound
- Definitions:
  - Minimum time bound: The earliest packet service completion time allowed
  - Maximum time bound: The latest packet service completion time allowed


Time bounds
Unbounded
Left-bounded
Right-bounded
Bounded
The time bounds criterion is the most significant. We decided this to be the first level categorization criterion.

Category selection process (2/5)

- Interdependencies of criteria
  - For a solution with only max time bound, the max bounds of packets directly decide the scheduling. No other criteria is important. No more categorization is necessary.
  - This makes the Right-bounded category to be a suitable category.

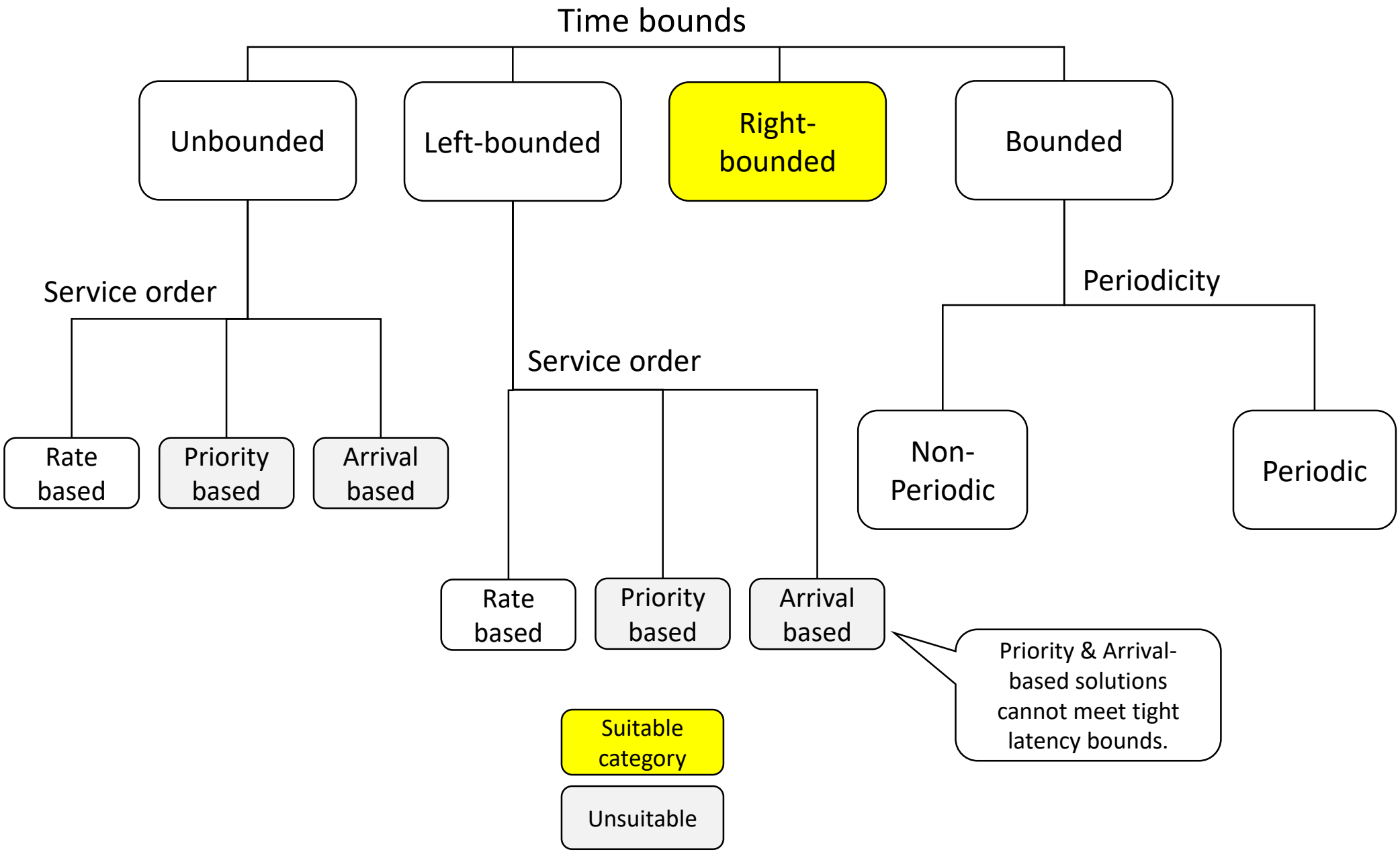

Time bounds
Unbounded
Left-bounded
Right-bounded
Bounded
For a solution with only Max time bound, these bounds of packets decides the scheduling order.
No other criteria is necessary.
If a solution assures every packet is right-bounded at every node, it is suitable for DetNet.
Suitable category

Category selection process (3/5)

- Binding of criteria
  - *Periodicity* & *Network Synchronization* → These are merged into *Periodicity*, because every periodic DetNet solution should be frequency synchronous for scalability.
- Interdependencies of criteria
  - Solutions without max time bounds cannot be described by *Periodicity*. They should be described by *Service order*.
  - Bounded solutions are better described by *Periodicity*. The service order within a slot is not important.

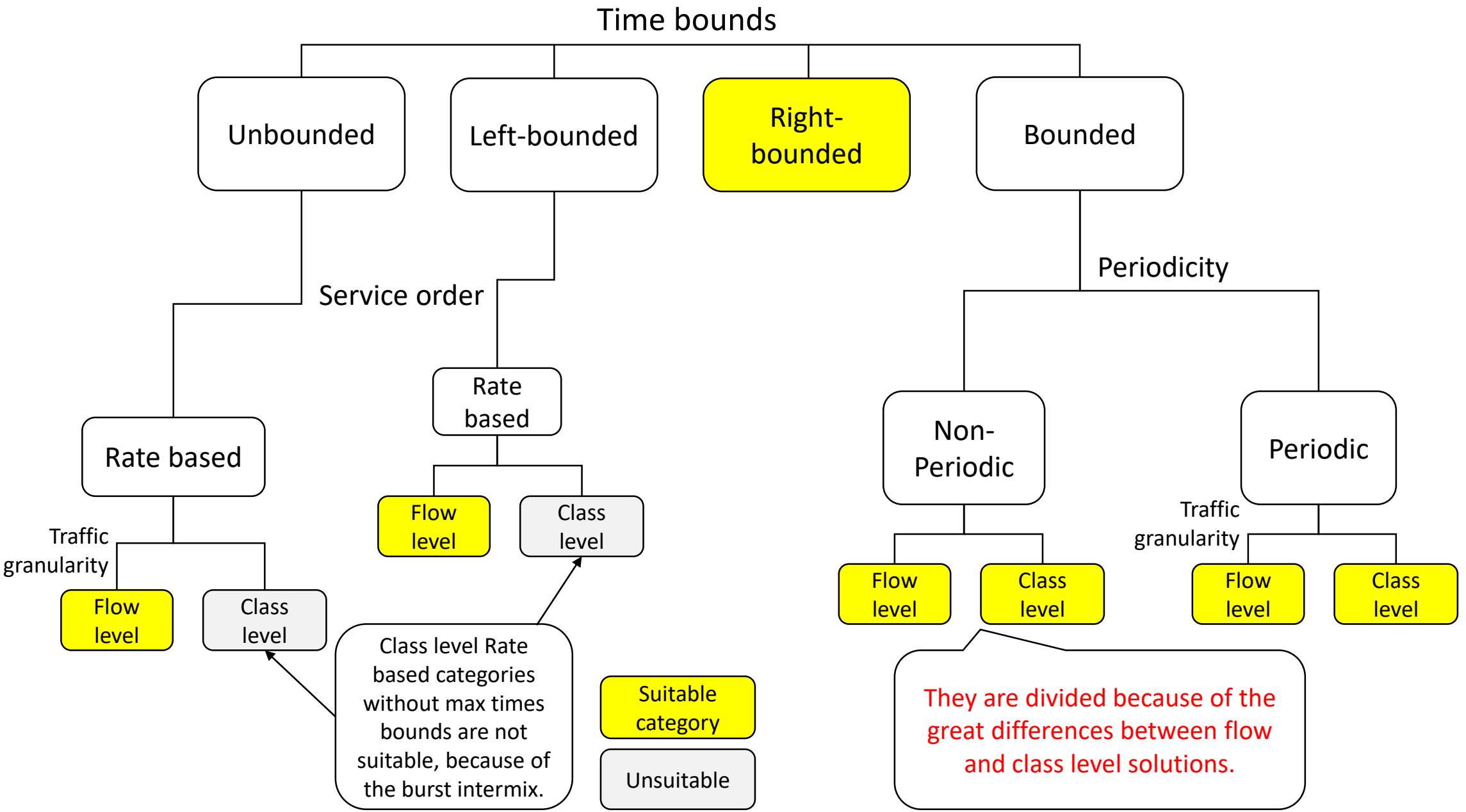
Category selection process (4/5)

- Exclusion of categories
  - *Service Order* criterion now categorizes solutions into Rate-based, Time-based, Arrival-based.
  - Priority-based (e.g. Strict priority scheduler) and Arrival-based solutions (e.g. FIFO scheduler) cannot meet tight latency bounds. These subcategories are not be considered suitable.

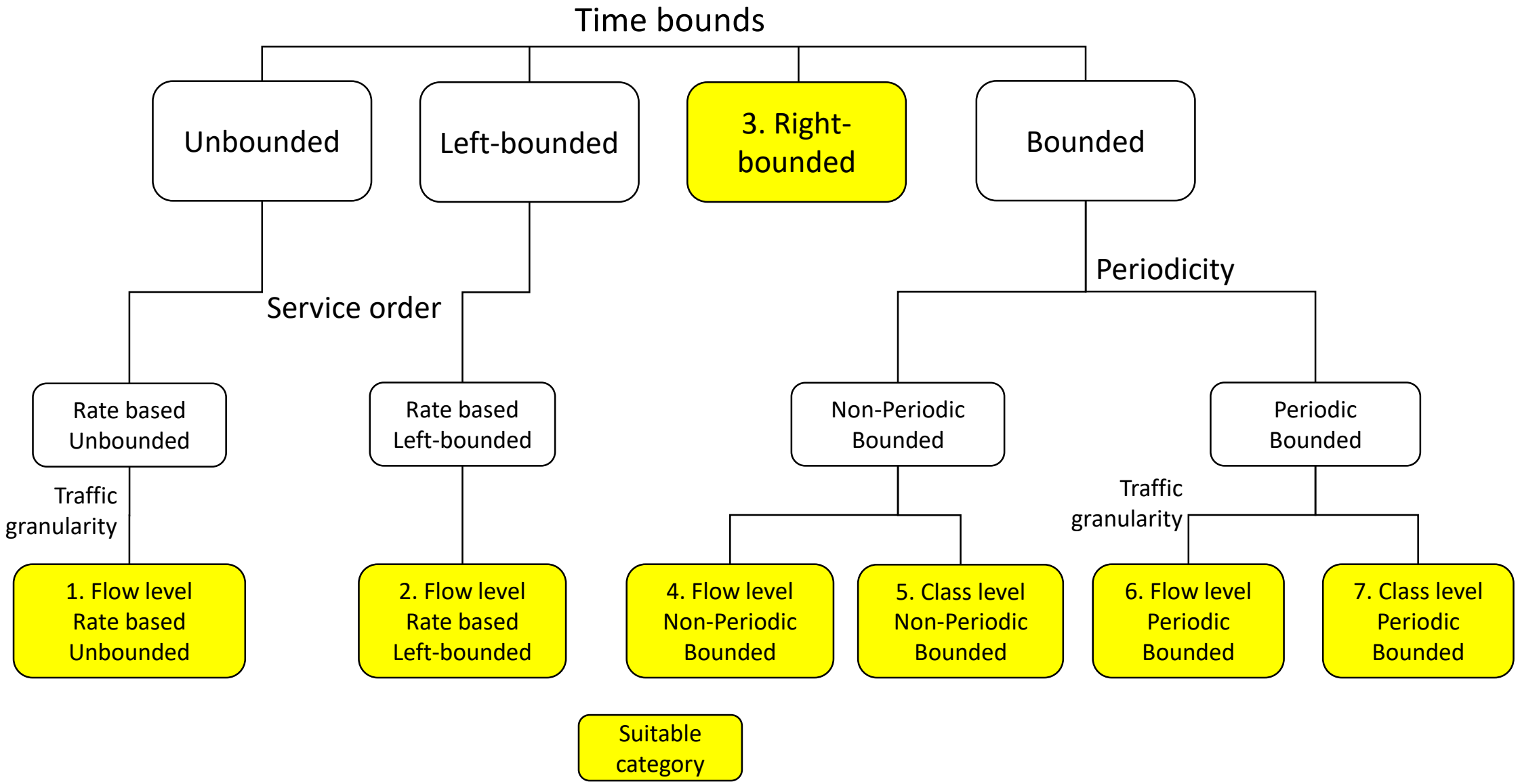

Time bounds
Unbounded
Left-bounded
Right-bounded
Bounded
Service order
Rate based
Priority based
Arrival based
Service order
Rate based
Priority based
Arrival based
Periodicity
Non-Periodic
Periodic
Priority & Arrival-based solutions cannot meet tight latency bounds.
Suitable category
Unsuitable

Category selection process (5/5)

- Binding of categories
  - *Traffic Granularity* which categorized solutions into either Flow, FA, or Class level, now has only two categories; Flow and Class level. Flow & FA are merged into Flow, because there can be some cases where the distinction between a flow and a set of flows are blurred.
- Exclusion of categories
  - Class level Rate based categories without max time bounds are not suitable because the interference due to the burst intermix within a class is troublesome to flow with small burst.


Time bounds
Unbounded
Left-bounded
Right-bounded
Bounded
Service order
Periodicity
Rate based
Traffic granularity
Flow level
Class level
Rate based
Flow level
Class level
Non-Periodic
Flow level
Class level
Periodic
Traffic granularity
Flow level
Class level
Class level Rate based categories without max times bounds are not suitable, because of the burst intermix.
Suitable category
Unsuitable
They are divided because of the great differences between flow and class level solutions.

Result: Seven categories are selected as suitable



Future plan

- Stabilize the document
- Start the approval process
- Note: This document is not meant to nominate or select candidates for each suitable categories.

Thank you

- Please take a look at

  https://datatracker.ietf.org/doc/draft-ietf-detnet-dataplane-taxonomy/